# Fly Ash Slurry Injection (FASI) of Bituminous Thermal Cracks

# Schedule

- What is Fly Ash Slurry Injection (FASI)
- Thermal Cracks and Why They Depress
- Pavement Rehab Strategies
- Special Provisions
- Upcoming Projects
- Questions

# Brief Overview of FASI

- What is FASI?
  - FASI consists of injecting a fly ash slurry into the voids beneath thermal cracks, stabilizing the soil and filling the voids.
  - Initially used in Kansas along I-70 in the 1990s
  - Kansas reported it to be a cost effective treatment for thermal cracks
  - Used on a Dawson County project in 2010
    - Overton to Sumner Road and Road 756

# Brief Overview of FASI

- Goal of FASI
  - Reduce the reflective cracks
  - Prevent cracks from depressing, in a cost effective way.
- Where it will be used
  - Districts 5, 6, 7, and 8 initially.
  - Currently 2 projects planned for each district
  - Statewide eventually.

# Schedule Update

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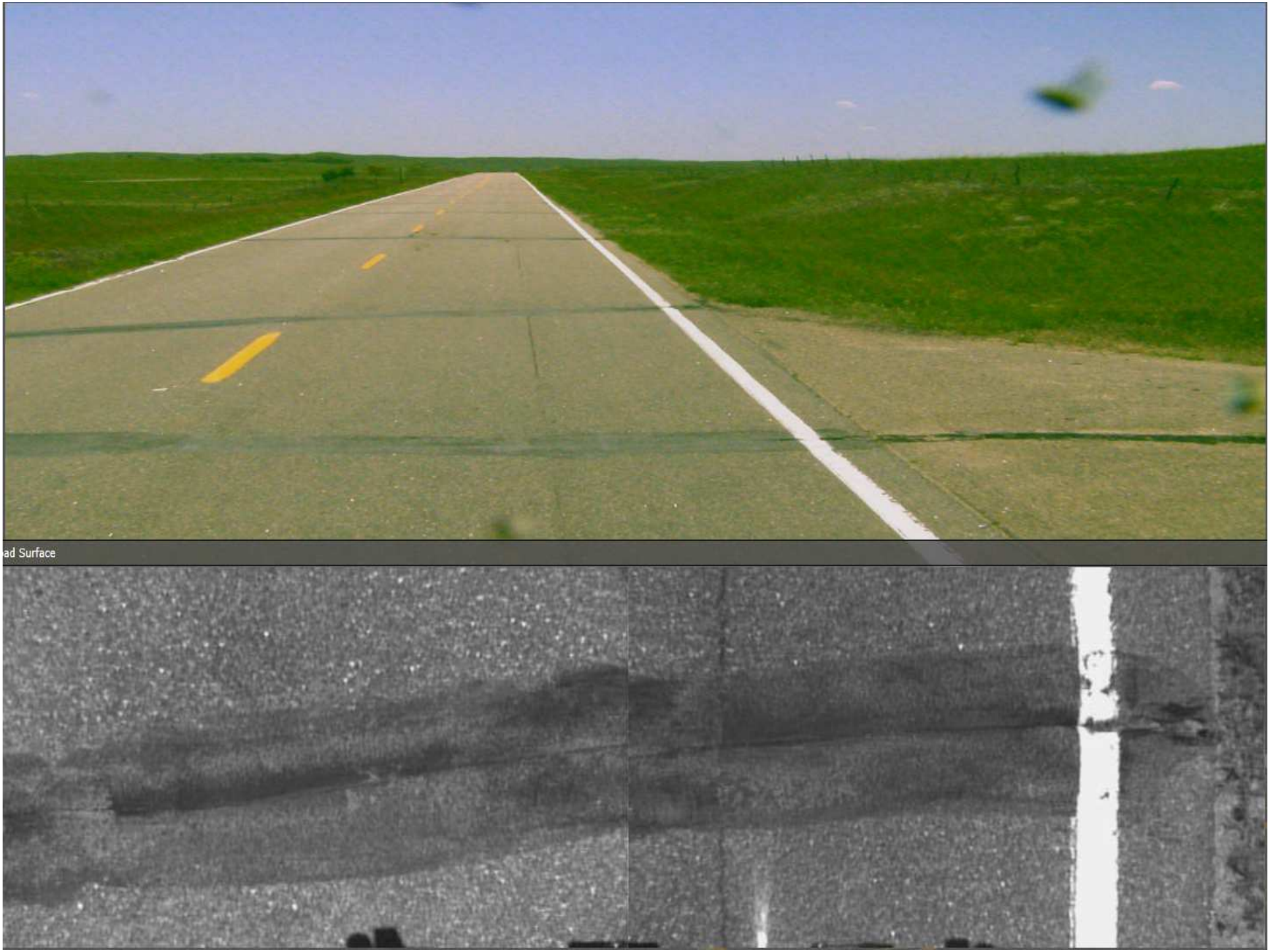
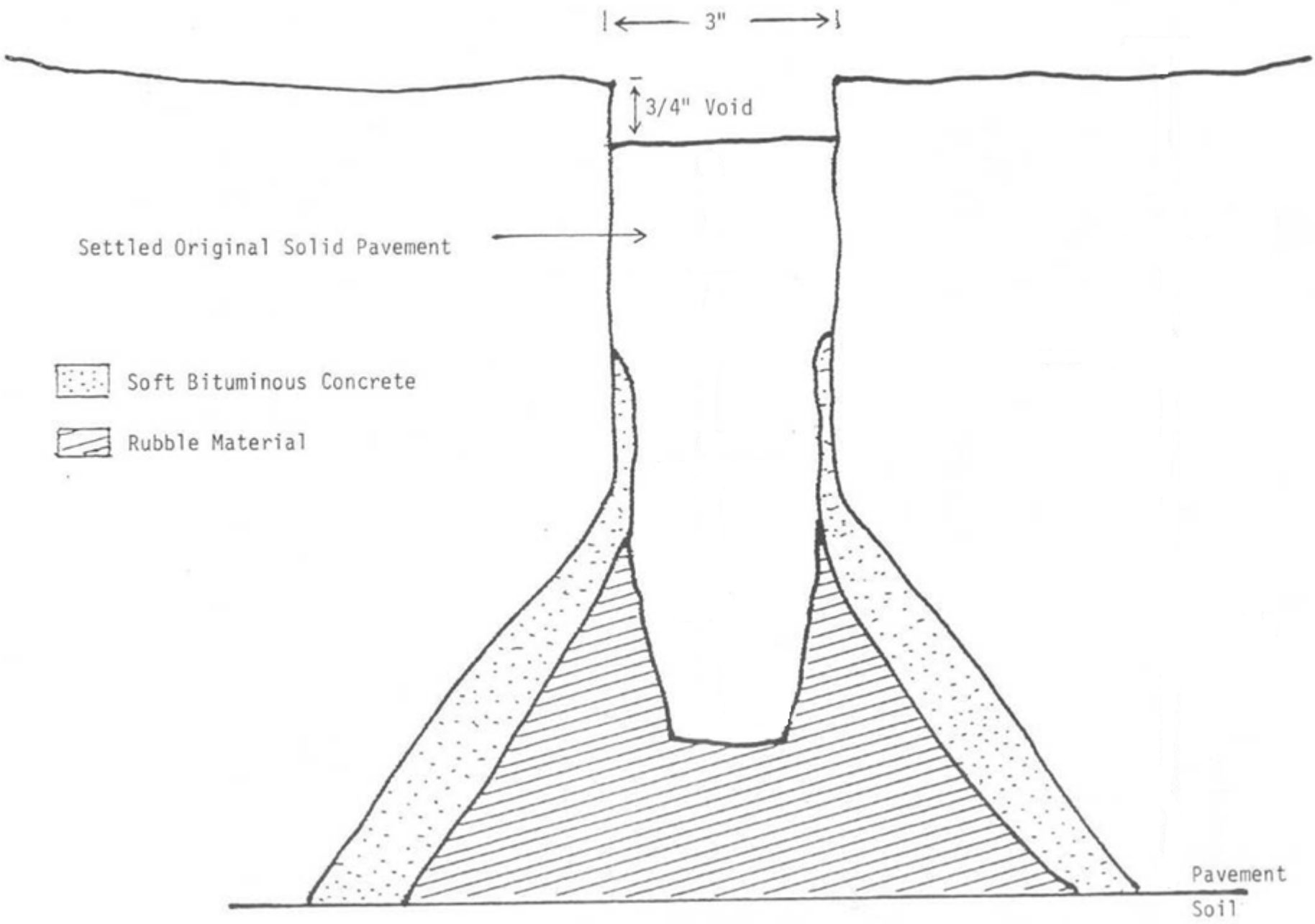

ad Surface

# Reason Cracks Depress

- Initially caused by a large temperature difference between the base and surface of the pavement, creating tensile forces.
- Tensile forces > AC strength, crack forms, water enters and weakens the subgrade.
- Moisture eventually degrades base pavement
- Traffic loading causes the cracks to depress


3"
3/4" Void
Settled Original Solid Pavement
Soft Bituminous Concrete
Rubble Material
Pavement
Soil

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# Pre FASI - Limited Rehab Options

- Surface Sealants and Patching
  - Short term fixes
  - Slows the development of the cracks
- Mill/Fill
  - Cleans up surface distresses
  - Medium term fix.  Cracks reappear at a rate of 1” per year.
- Mill/Fill with a Geo-textile
  - Retards crack reappearance and potentially seals crack from further moisture.
  - Geo-textiles can be difficult to work with.
  - Similar cost per Sq Yd as 1-2” of asphalt
- Partial or Full depth recycles
  - Full depth recycle only way to permanently eliminate cracks
  - Long term fix.  Costly, grade raise, not always practical or desired (high traffic, thick pavement)

# Incorporating FASI into the Rehab

- Initially, looking to use this strategy on mill/fill projects.
- Expand to more armor coat surfacing type projects if effective.
  - Pavements we would target:
    - Structurally sound
    - Thermal cracks the main distress

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# Special Provisions

## Material Requirements

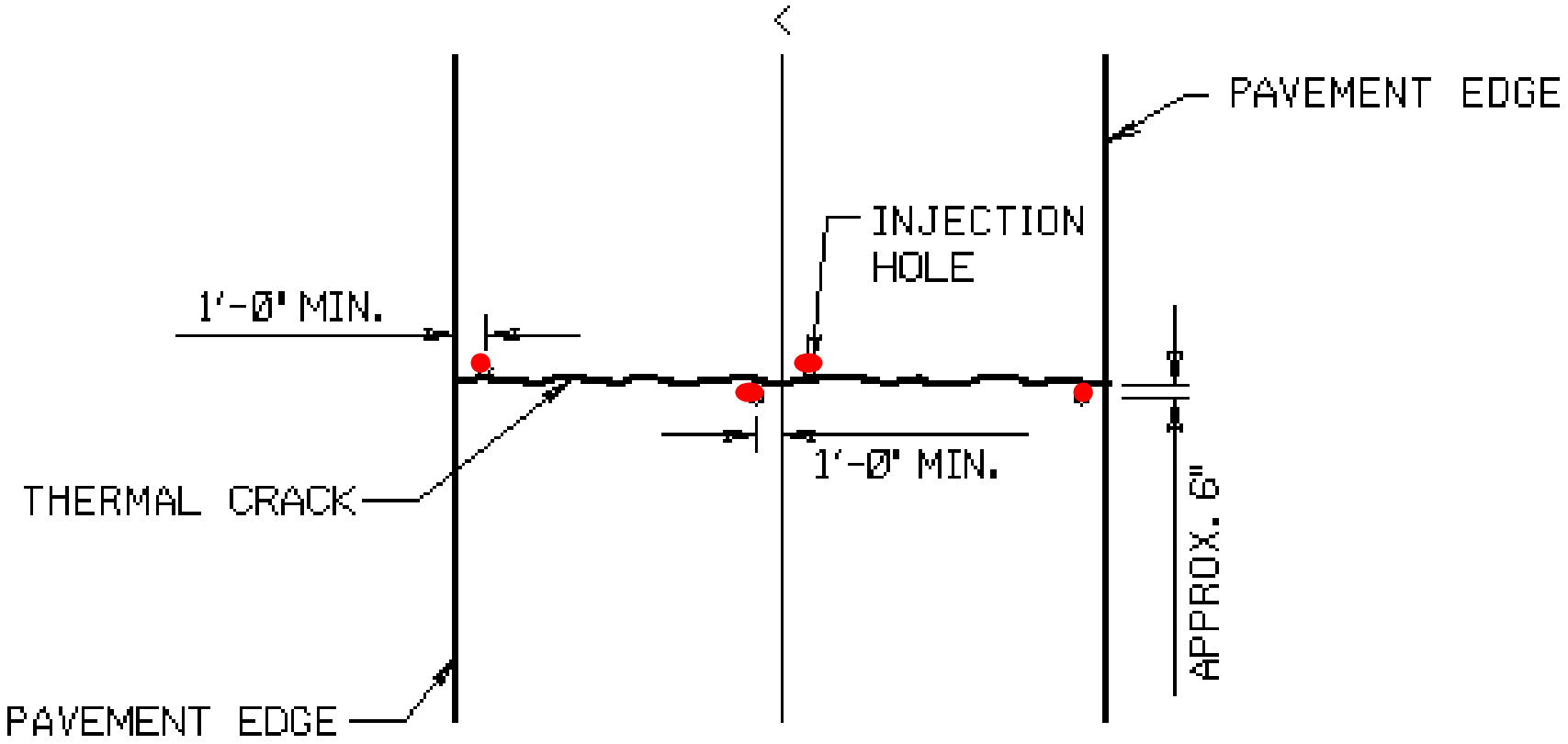
- Fly Ash Slurry mix design report submitted to M&R a minimum 15 days prior to beginning construction.
- Minimum 7 day Compressive Strength of 400 psi
- Traffic will not be placed on driving lanes until the material has reached initial set.
  - Initial set has been reached when it can be stepped on without sticking.

# Special Provisions

## Construction Methods

### Injection Holes

- Department will determine which cracks will be filled
  - Not looking to treat every crack, mainly the depressed ones.
- Drill a minimum of 2 holes per 12’ of crack length
- Holes shall be approximately 6” from the crack and 12” from the pavement edge or center line.
  - Expect outside holes closer to the wheel paths.




# FLY ASH SLURRY INJECTION DETAIL

| STATION | TO | STATION |
|---|---|---|
| * | - | * |

# Special Provisions

## Construction Methods

### Slurry Injection

- Temporarily plug adjacent hole if doing so will force slurry into the crack. Also used to prevent back flow.
- Control injection operation to prevent pavement lift greater than ½". Check with a 10' straight edge.
  - Intent of injection is to fill the void and remove depressions while being able to open to traffic without immediate milling.
- If pavement lift produces an unacceptable ride, pavement will be milled prior to opening to traffic, at no cost to the department.


JUL 21 2010

JUL 21 2010


JUL 21 2010

# Special Provisions

## Construction Methods

### Clean Up

- Any overflow material shall be squeegeed from the surface as directed by the Engineer

JUL 21 2010

# Special Provisions

## Construction Methods

### Weather Limitations

- Do not perform FASI if the air temperature is 50° F or below or if the ground if frozen.

- Do not perform FASI if weather conditions prevent proper handling and placement of materials.

# Special Provisions

## Sampling and Testing

- Determine the density of the slurry prior to starting work each day.
  - Density calculated in lb/gal by using Gardner Cup
    - Used as a measure of consistency
    - Used for calculating total slurry applied (T).
- Use provided table to record the daily densities and calculate the (T) values.
  - Include table in project file and submit to M&R.

# Special Provisions

## Sampling and Testing

- Department will mold a minimum of one set of test cylinders per day
  - Set consists of four cylinders, two of which will be tested on the $7^{th}$ day and two held in reserve.
  - The average of two compressive strength tests will be used to determine payment.

# Flv Ash Slurrv Iniection of Bituminous Thermal Cracks

| Cylinder Records | | | | |
|---|---|---|---|---|
| Required Daily Cylinder ID (1 set) | Average Compressive Strength (psi) | Additional Cylinder ID (Optional) | Average Compressive Strength (psi) | Pay Factor (Lowest Average Strength) |
| | | | | |

| Date | Station Range | Gardner Cup Density (lbs/gal) | Total Daily Volume (gal) | Total Daily Weight = A*B (lb) | Total Daily Weight = C÷2000 (T) |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
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| | | | | | |
| | | | | | |

# Special Provisions

## Sampling and Testing

- Pay Schedule
  - 400+ psi = 100% pay
  - 300-399 psi = 80% pay
  - <300 psi = 40% pay

# Special Provisions

## Method of Measurement

- Pay Items
  - Fly Ash Slurry Injection
    - Paid for by the Ton
    - Water, Cement, and Admixtures are subsidiary
  - Injection Holes
    - Measured by the number of holes drilled.
    - Monitoring for pavement lift subsidiary to the injection holes
- No adjustment in contract unit prices are made regardless of amount of over/under-runs

# Additional Special Provisions

- 1/2” pre-mill due to residual fly ash slurry
  - Anticipating the Contractor’s preference to not incorporate this material into the RAP
- 14 days between FASI and first Mill
  - Due to public complaints on County project
- 30’ ski on milling machine for smoothness
- Will Include a core report if available

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# Upcoming Projects

## Projects for 2012

- Agate South, STP-29-4(107), CN 51361 – FASI w/ District Armor Coat
  - 3” AC on 6” crushed rock base, 220 ADT 10% trucks
  - 10.5 miles in length
  - Low cost maintenance strategy was desired
- Hyannis North, STP-61-3(109), 61473 – FASI and Mill/Fill 3”
  - 4” AC on 4” Bit Sand, 400 ADT, 10% trucks
  - 7 miles in length

# Upcoming Projects

## Projects for 2013

- N Jct US 83 West, STP-23-2(125), CN 61475
  - FASI and Mill/Fill 3.5”
- Sparks West, STP-12-2(105), CN 80877
  - FASI and Mill 3”/Fill 4”

# Upcoming Projects

## Beyond 2013

- Danbury to Lebanon, STPD-BH-89-2(110),CN 70890, FY 2014
- Wauneta to Hamlet, STP-6-2(130), CN 71127, FY 2015
- Burwell North, STP-BH-11-3(118), CN 80798, FY 2015
- I-80 North, STPD-27-2(104), CN 51277, FY 2017
- Additional projects likely

Questions?